

1807
CONSERVATORIES &
ORCHARD HOUSES.

CRANSTON'S
PATENT BUILDINGS FOR HORTICULTURE!



FOR PARTICULARS
AND PLANS,
OR COST OF ERECTION,
APPLY TO J. CRANSTON, ARCHT.
No. 1, TEMPLE ROW WEST, BIRMINGHAM.

HOTHOUSES &
GREENHOUSES.

PRICE, one & six Pence.

L. Underwood, Lith. Firm.

AN ACCOUNT
WITH
ILLUSTRATIVE SKETCHES
OF
CRANSTON'S PATENTED BUILDINGS,
AS APPLIED TO
HORTICULTURE.

DATE OF PATENT, AUGUST 24TH, 1861. NO. 2117.

1, Temple Row West, Birmingham,
February, 1862.

HORTICULTURAL BUILDINGS.

BY

HER MAJESTY'S ROYAL LETTERS PATENT.

No. 2117.



AMONG my engagements as an architect, horticultural buildings have not unfrequently claimed my attention; and, excepting some recent erections, these have all been of the ordinary kind—parallelograms of different sizes, with upright sides and ends either wholly of brickwork, or brickwork under wood and glass, and straight lights or rafters resting upon the upright sides, and meeting together at the ridge.

Sometimes a variety of shape was produced by having one side of the roof longer than the other—of the salt-box fashion—or the space, width-ways, was covered by three roofs, the centre one resting upon columns and rising above the sides—like the nave and aisles of a church.

Or, with further change and more pretension, the conservatory was attached to the drawing-rooms of a residence, and had wood

columns and Gothic-headed arches, filled in with tracery of great elaboration for its front, and arched and carved timbers for its roof; the latter being partly shut out from sight, when viewed externally, by the eaves cornice, with its mouldings and battlements standing before it.

These buildings, although very common-place, and constructed without any desire to leave the deeply-trodden path in which designers and builders of such erections have been trudging for the last sixty or seventy years, were considered satisfactory, and, being pretty full of glass—which, from its beauty, is always pleasing to the eye—were pronounced handsome in appearance.

But, if these houses, or any others equally poor in outline, meagre in character, and tame in design, had been covered with opaque instead of transparent materials, the very ugliness of them would have pained every one who saw them, proving—if the fact does not do so that many houses are placed as much as possible away from the lawns, or out of sight of the principal rooms—that in form there is nothing picturesque about them.

Much money is often spent upon "Architectural Conservatories," and, in many cases, with considerable success; but, however well such buildings might group with the wings, terraces, and towers of the mansions of which they form part, it will always be very questionable how far pilasters and arches with massive cornices—arranged to hide glass roofs which ought to be seen, and shading plants which, in this country, require

the full power of the sun—can be considered in keeping with buildings for fruit or plant growing purposes.

So much has been done, of late years, to improve and cheapen glass for horticultural and all other uses, and so many marvels have been produced in iron and glass since the honoured pioneer in such works erected his '51 Exhibition Building, that it seems strange the improvements in buildings of wood and glass, for one of the most enjoyable and perhaps the most health-preserving and innocent of all pursuits, should have made such small progress.

But so it is: the house of last year is the house of this; the one succeeding the other as a matter of course. When more glass is required, the gentleman or his gardener orders a house for the growth of plants or fruit, and his builders, with a painfully free use of timber, iron, and bricks, put up a "span roofed" erection, with flaps in the roof to lift up or slide down, and side sashes to open outwards, all worked by costly and complicated pieces of machinery, and intended to act as ventilators, but, in reality, proving far better suited to admit the wind and rain in most immoderate quantities.

Under the head of ventilation, in "The Book of the Garden," Dr. Lindley is reported to have thus written:—"When a man builds a forcing-house, he settles carefully the slope of the roof, the nature and direction of the heating apparatus, the material for the shelves and floors, the quality of the glass, the size of the squares, and the depth of their laps; whether the door

“shall be at the end or side, and the whereabouts of the stoke-hole, are other points of grave deliberation. How, then, are we to account for the almost universal neglect of the most important of all—the Ventilation? But no: we wrong the builders of forcing-houses;—they do not neglect ventilation; on the contrary, they provide for it copiously. They make the roof sashes slide, and the side windows unfold, and the doorway alone administers no inconsiderable doses of wind. In fact, the ventilation—if by that term is meant the *letting in of wind*—is in no ways deficient. But, unfortunately, this is not precisely “what plants require.”

Few have written more, or better, for horticulture, than Dr. Lindley, and, among all the good things he has penned, he could never have been more correct than we find him here; for, as a rule—and a wide one too, with its exceptions few and rare to meet with—our plant-houses are mere pieces of ill-conceived carpentry, filled with glass.

With the object of bringing about beneficial changes, it is oftentimes not amiss to refer to defects and shortcomings which have been set right; and, as horticulture and agriculture are naturally always in connection with each other, this can be done by noting what has taken place in the latter science.

It is only within the years of a middle-aged life, that most of the great improvements in all that appertains to the cultiva

tion of our fields have been brought about; and, among the results of the hundred and one happy changes, we have more perfect arrangements for housing and feeding stock—wet lands drained, and made productive and dry—and labourers' cottages transformed from ruinous ill-arranged huts into decent and comfortable homes.

Let the short memory be taxed to discover what a plough used to be—a heavy drag for half-a-dozen horses or more oxen, slowly struggling through a badly-turned furrow, of very shallow depth—the make of the implement continuing much the same from generation to generation—or to note what then could have been the substitutes wherewith to work the land, for the clod-crushers, the scufflers, or all the other modern implements, that have become almost as necessary to the farmer as the soil he tills.

In many parishes there are now more steam-engines for threshing, grinding, cutting, and pulping, than, fifty years ago, there were ploughs—more horses now, when steam does much, and two are enough for a plough, than then, when steam was not, and each plough took six—more men and women well employed with the present machinery upon farms, than there ever were without it.

But, when the farm lands were all wet and weedy, yielding not half as much in beef, and mutton, and corn, as they now do, the gardener grew his grapes and stone-fruit, and cultivated his flowers under glass—the same glass being duty-taxed, dear, and bad. He long has known the value of dry sub-soils, deep

trenchings, and top dressings, and ever has had an instinctive horror of cutch-grass, docks, and all such like evidences of bad cultivation.

If it is said that Horticultural progress, in our time, has not been equal to that of Agriculture, the easy reply is—when Agriculture was remarkable for its sloth, Horticulture was making headway, and has continued to do so, in a gradual manner, to the present time, instead of leaping forward at one spring, as Agriculture has done, from lands where thistles and brambles, rushes and mosses, so long held and enjoyed possession, to corn-fields as we now see them, gold-like with ripeness at harvest-time, and meadows full of grass and well-fed cattle.

Perhaps, in recent times, one of the most notable steps—a small one at first, but quite in the right direction—to the advancement of Horticulture, in one of its branches, was that taken by Mr. Rivers, when he brought out his “Orchard Houses,” to extend and secure the growth of fruit in this uncertain climate; and, although the system of growing fruit trees in pots under glass is not so new as some say, by calling attention to it great good has been done; for now the time does not seem far distant when every garden of a few perches will have its fruit-house full of grapes, peaches, nectarines, and apricots.

In the suburban districts of large towns, where the garden space is necessarily limited, this growing fruit under glass has already been found a most agreeable and profitable employment,

and, when better constructed buildings are used, these advantages will be much greater.

From the slight and very unsatisfactory manner in which these houses were at first built, the very name of "Orchard House" now conveys to many minds something far more like a rough shed than a green-house; and this is much to be regretted, for the term is a good one, and the buildings ought to be fully worthy of it.

Although the hornbeam hedges, which were to answer the purpose of back walls in these orchard houses, have now given way to boards and shutters, there is still great room for improvement; and, if we would afford thorough protection to fruit trees—and especially during the changeable weather of our spring months, when the plants are about to show for bloom, and until after the fruit is set and considered safe—we must have something better than rough carpentry and hornbeam hedges; besides, the trees are, to a certain extent, under artificial treatment, and are, therefore, more than ever in need of shelter that is fully effective during severe frosts, north-east winds, and hail storms.

Badly constructed houses can never be depended on in any extreme weather, as many who have used them can but too well testify; and if they are looked upon as places *to be ventilated*, this is quite out of the question, for any system of effective ventilation must always be under control—an impossibility with buildings which are open at all times to the cold winds, frosts, and snow, through their numberless slits, opened joints, and cracks.

If "whatever is worth doing is worth doing well," an un-hewn shed, stuck upon larch props, with either a hedge or boarding in lieu of the back wall, will ever be regarded as a paltry arrangement, alike unreasonable when viewed from all points—that of cost, perhaps, excepted; but even here it fails, for another trite old adage tells us "nothing can be cheap unless it is good," and we know that, in the buildings to which the name of "Orchard House" was first given, cheapness of construction was most unfortunately productive of flimsy workmanship, great ugliness, and a painful make-shift character throughout, with which the public will assuredly quarrel, if it has not done so already.

The importance of getting these fruit-growing places [as cheap as is consistent with suitable materials and workmanship, and a due regard to appearances, is undoubtedly very great; and equally necessary and important is it to build them in such a way that they may, in every respect, be quite as well suited to the growth of plants and flowers as fruit; for, when properly constructed with this double application in view, they are so easily managed and give to their owners such satisfactory results, that the possession of one by every householder who has space for its erection—and their sites, in the absence of gardens, might be in yards, against house or other walls, upon house porches or roofs, or projecting from house windows—would necessarily be followed by happy consequences; for what occupation, between the times of labour, is so likely to endear a man to his home, as the daily pleasure, in which his wife and children join, of tending trees and flowers.

In speaking of what has been called the "Orchard House," reference will be made to it as it should be, and not as it often is; and the name is not intended to be used in a narrow or exclusive sense, but to apply to a building having, in the kind and quality of the materials composing it, and in the way they are put together, every requisite for protecting and fostering any sort of flower, plant, or fruit; and that every orchard house should be sufficiently well-built and designed to accomplish this there can be no doubt—the addition of necessary fittings and some heating apparatus alone being requisite to convert it into a hot-house.

The wonderful and delicate works of nature, that go on so regularly and yet so silently among the blossoms, at the time they are setting their fruit—when a dry, warm atmosphere is necessary, that the farina might be as the lightest dust, and not become too damp and weighty either to fly on its mission of impregnation or to be picked up and carried for that purpose by the bees and insects—clearly show that, at this period, if at no other, the fruit house must, as far as possible, be complete in its shelter and perfect in its ventilation.

To provide against the changes of temperature, which so often, and with much suddenness, leave our fruit trees barren and useless for one season at least, and to meet the increasing demand for fruit of fine quality, the only way is to protect the trees by glass; and to show that this can be done cheaply and effectually in houses which, besides being applicable as hot-houses

and conservatories for the propagation and growth of flowers and plants of any description, are elegant in design, substantial in make, well ventilated, and portable, this little book is, with much respect, placed before the Public.





The two accompanying sheets of sketches will, to some extent, explain how houses of this Patented principle can be fashioned to suit the various circumstances of site, shape, size, and cost; and will show that, among the peculiarities of the general design, there is an entire absence of framed joiner's work, such as sashes and lights, either sliding or fixed, with all morticing and tenoning, or other expensive workmanship, and that the roofs of the houses, instead of being even-surfaced, are curved or arched by a divisional arrangement of the glass into horizontal sections, each compartment being fixed at a different angle, so that curvilinear roofs of any contour are produced, and this with the use of straight instead of bent glass.

On the first sheet we have three lean-to houses, arranged to walls of different heights; the first of the three, or the one to the left hand, being 7 feet wide, and formed with a short side to its roof, hanging over the top of a 6 feet wall. There are four compartments of rafters filled with glass, each $3\frac{1}{2}$ feet long, three compartments towards the front, and one over the wall facing the contrary way, and these divisions are separated by what has been called, to distinguish them clearly, "Radial Ribs," fixed edgeways, and running lengthways of the building under the lower ends of the bottom rafters, and between the top and bottom ends of all the others: each radial rib, in all cases, irrespective of the shape or size of the building in which it is, or any other consideration whatever, being perforated, for ventilation, by small openings close to each other, from end to end, and having a valvular apparatus on the inside of it for properly regulating the ingress and egress of air, as will be more fully described hereafter.

To the bottom edge of each radial rib the upper ends of the rafters are secured, and upon the top side of it the feet of the rafters rest.

The external aspect of a roof so framed presents to the eye a series of planes fitted with glass, divided vertically by small wood rafters, and horizontally by the radial ribs, also of wood, so fixed to make the top of one plane recede a few inches that the lower end of the plane immediately above it might project and over-hang. The radial ribs are themselves fixed to other timbers, put together in the shapes necessary to receive them, and which act as "principals," spanning the house internally at intervals of about 8 feet.

The description of this part of the construction of one house will fully apply to all the illustrations, whether of lean-to or span-roofed buildings; the only exception being, that the lean-to house at the bottom of the page has, in the middle of the lower plane, a bar for the glass, instead of a radial rib.

The house on the right-hand side of the page, opposite the other lean-to, stands against a taller wall, is 6 feet wide, and has three radial ribs dividing the roof into three planes.

The same principle, of planes of glass and wood, with radial ribs between them, is carried out in the span-roofed house at the top of the page, and which, in plan, is shaped like a cross, the arms being shorter than the centre stem.

Referring to the next sheet, upon which we have a conservatory filling up the angle of a small villa, and above it the section of a span-roofed house, giving a view of the inside, the application of the principle will be further comprehended, and the great ease with which it can be adapted to any situation will be well understood.

No good reason can be given why fruit houses should be commoner in kind, or less agreeable to look at, than houses for plants and flowers; and neither can it fairly be advanced that the orchard house should not be made equally suitable for general purposes; for, if we take the appearance of two houses into consideration, the one full of plants in blossom, and the space in the other wholly occupied by trees loaded with fruit, it is a question which is the more interesting and pleasing sight.

Nor, for the sake of cheapness or from any other cause, should it be permitted to make fruit or plant houses inconvenient to move about in, for if there is not sufficient head-room everywhere, people will soon tire of going into them, and the recreation such buildings ought to afford within cannot be obtained.

If, in addition to being places for the growth of fruit and the blossoming of plants, they are also available for promenades, where cold east winds cannot enter, and the air, without being heated artificially, is ever balmy, fresh, and pure, what an agreeable and important second purpose are they made to fulfil. But, in many instances not difficult to contemplate, this promenade

will not be of the second, but of the first consideration; for an approach to the genial air of a south climate, in our own garden, at the cold parts of the year, will be—to the aged and invalided, of the greatest—and to all, of considerable importance.

A winter garden, as such places have been called, where air and exercise might be taken by the most delicate without risk, and that, too, among objects that please all, from the infant in arms to the oldest person, is an addition to an establishment that has always met with especial favour; for there the quiet walk, or the lounge for a short time each day, is a most beneficial change for the invalid or convalescent; and those who have had long illnesses and confinement to the sick room, know full well how the heart delights when the eye again meets the refreshing greenness of the trees, and the beauty of blooming flowers,—but these advantages necessitate the essential every glass house ought to possess, namely, sufficient head-room.

Besides, there is a mean and pinched appearance about a house like a tent, with its sides meeting the ground at acute angles, and its narrow strip of walking-ground as a matter of course along the centre, and available, without risk to the glass roof or the walker's head, only so long as his steps are true and within the limits of the prescribed path.

Houses like these, with each side forming one slope or plane up to the top, cannot have the full benefit of the sun's rays, which scarcely ever fall upon any part of the glass at

right angles; and exactly where the sun has most power, the space, internally, is so small—from the tops of the lights on each side meeting at a point—as to be nearly useless.

Houses of glass, to a great extent, at the present time, must be regarded as places for the amusement, recreation, or enjoyment of the affluent, and, therefore, we have another reason why they should be erected not only in a substantial and useful manner, but, as far as possible, in an elegant one too. Anything to continue satisfactory and pleasing, must not pall the senses, be they those of the palate, the eye, or the ear; and although it occasionally happens that novelty, in taste, in form, or in sound, holds its own with us for a time, unless the meat or fruit is good, the picture or building really fine, or the music sweet the end of our admiration is quickly seen.

When we look at a plant house of any kind, there is always disappointment if we do not see plenty of glass. In such a building it is not wood, or stone, or brick, however framed, carved, or painted, that the eye should dwell upon. Glass is the essential for the plants, and glass alone the eye delights to see, until the spectator is inside the building, when the more beautiful objects of nature, in the shape of fruit or blossoms, claim his attention.

Side and end walls are both costly and ugly, and, upon reference to any of the houses shown in the accompanying illustrations, or to the three more immediately in connection with this page, it will be seen that they are not requisite in the formation of glass buildings for fruit and flowers, although, in stove or propagating houses where considerable artificial heat is required, and in which it is thought necessary to place the plants on stages, walls of brickwork can be used and should be as high as the tops of the outside stages, when the first ventilating rib, or perforated radial piece, will be level with the plants next the glass, and the arched roof will spring from the walls just as readily as it rises from the foundation piers in the ground; the main difference being that external appearance has to some extent been sacrificed for what might be regarded as internal usefulness.

A house, almost entirely of glass, rising in a curvilinear shape directly out of a green lawn, with no horizontal patch of brickwork under it, red and monotonous—no heavy timbers or framing, large and strong, to make up for immatured design or bad construction—no flaps or shutters gaping outwards, to form holes for rain and wind—is a building, the beauty of which must be seen to be understood, for mine, at least, is not the pencil adequately to portray it.

Expense is greatly in favour of the full and free use of glass as compared with bricks or wood. For instance, the beautiful horticultural glass now made by Messrs. Chance Brothers, of Smethwick, costs from twopence to sixpence a foot, according







to its weight and quality, and the sizes of the squares used; but brick-work, nine inches in thickness, averages about four shillings a yard, or nearly sixpence a foot; and wood-work, when taken as framed into lights or cut into rafters, must be worth, including painting, at least a shilling a foot.

Glass, then, cannot be too liberally used, always bearing in mind that buildings so constructed must be efficiently ventilated, for it is remembered that the arched houses of light metal-work, as in fashion some years ago, were all, more or less, failures, not from receiving too much sun, as some thought, but because they did not admit sufficient air to keep the plants healthy. The builders of these houses were not wrong in the shape or pitch of the roofs, and it is doubtful if the material employed to hold the glass was very objectionable, but they forgot that plants under metal and glass sloped to catch the greatest possible quantity of sun, would grow sickly, curl up, and die, if not regularly supplied with very copious doses of atmospheric air.

Here there was a beginning at the wrong end; for builders, not only of glass houses, but of all other houses and erections whatever, should never lay a brick, or drive a nail, till the plan of ventilation is thoroughly digested; for of what advantage is the well-arched glass roof, with its panes directly facing the sun's rays, if all within it withers and dies for want of pure air?

Placing the various horticultural buildings, one after the other, before us, commencing with the early ones, which we

copied from the Dutch, and going through all the changes down to those of our own day, it certainly does appear that their authors designed them first, and schemed as best they could for the ventilation of them afterwards. As well might we build a dwelling-house, roof it in, and finish it, and then see where the walls could be pierced for the doors and windows, or then determine where the fire-places and chimney-stacks could be placed; for a good and constant supply of air is not more necessary to the dwellers in the one house than it is to the plants in the other.

When glass was four or five times its present price, besides being then of very inferior quality, there was some reason why builders should have used it sparingly, but now the case is altered; it is long, wide, clear, and cheap, and should be employed in such ways that as little as possible of anything else is needed in houses for the propagation and protection of plants. All the advantages of improved manufacture, which are now placed to our hands upon such easy terms, should be turned to good account, and, instead of using small panes, with "laps" every eight, ten, or twelve inches, the pieces should be as long as they can be procured.

Laps, in glass, always become black from collecting the dirt, and, in damp weather, water hangs for a time between the two edges, to find its way into the house, or, when frost comes, to freeze, and cause the glass to crack. Upon this point, Mr. M'Intosh, in his "Book of the Garden," remarks—"Under

“the old system of ventilation, plants prospered better in houses
“glazed with the over-laps left open, than in those that were
“cross-puttied, and still more so where the glass was small than
“where it was of the largest size, because there were many more
“openings for the admission of air from without—these openings
“being small, and very equally distributed over the roof. There
“is, however, no possible necessity for returning to that mode
“of glazing, which is so destructive to glass during frosts, as
“the same means may be obtained by a proper and equally
“diffused mode of ventilation.”

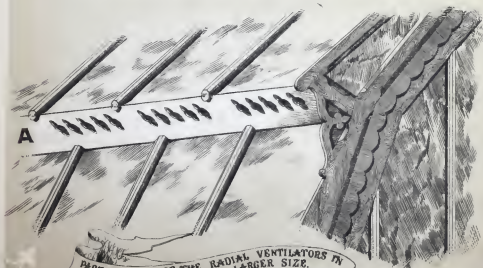
A glance at the following sketch, “part of the side and
end of a house, as erected at King’s Acre Nurseries, Hereford,”
with one of the radial ribs below it, drawn to a larger size, will
explain how this “proper and equally diffused mode of ventilation,”
“with openings being made small, and very equally distributed
“over the roof,” can be applied to all horticultural erections,
by the adoption of the Patented construction.

In each drawing the letter A points to radial ribs, which run from one end of the house to the other, and which are full of small perforations for the entrance and egress of air, with simple appliances on the inside for closing them at will.

The air, as it passes through these openings—each of which is two or three inches long, and about half the width—all standing in rows parallel with the ground, and three or four feet from each other, according to the length of the glass used,—is sub-divided into very many small currents, never reaching the interior in large volumes, and yet entering readily, and filling it, as the ventilators may be open or shut, by few or many streamlets. In “Useful Hints on Ventilation,” Mr. Walker thus writes upon the admission of air to other buildings:—“its introduction in large quantities, at one point, would produce “injuriously and unpleasant drafts and currents; proper attention “must be paid to its diffusion, so as to introduce it at as many “points as possible, and to sub-divide the currents into as many “smaller currents, as the circumstances of each particular case “will admit of.” This applies no less to plant-houses and plants than it does to our dwelling-rooms and the occupiers of them; for strong drafts are injurious in both cases.

It has been stated that, if a house is more than thirty feet wide, it must have a ridge and furrow roof; and, however correct this might be, in reference to other buildings, the principle upon which these are designed will allow of any width, from ten to one hundred or more feet, being covered at one span,

PART OF THE SIDE AND END OF A HOUSE AS ERECTED
 AT KINGS ACRES HEREFORD.



PART OF ONE OF THE RADIAL VENTILATORS IN
 THE ABOVE TO A LARGER SIZE.

and with this most important difference in favour of the Patented buildings, that, as the width increases from the narrow house to the wider one, *so, exactly in like proportion, is the means of ventilation also increased.* For instance, in houses fifteen feet wide, there would be four radial ribs, or perforated ventilating pieces, on each side; but when the width is twenty feet, these would be increased to five; and with a width of twenty-five feet, to six radial pieces; and so on, in like manner, in buildings of greater dimensions,—the principle permitting of the largest erections being constructed as easily, and ventilated as thoroughly, as the smallest.

The drawings on the following sheets represent houses, each forty feet wide, with curvilinear roofs of one span, without intermediate supports. These roofs can be varied in shape to almost any extent, giving the buildings all the elegance and beauty of curved outlines instead of straight sides, and without it being necessary to use any other than flat glass; and which, as it is well understood how objectionable bent glass always is in roofs, being very costly in the first instance, but doubly so when a single pane has to be renewed—ever liable to crack and break—and always most difficult to keep from leaking—is a matter of the greatest importance.

As the radial ventilating ribs in the patented houses are made to carry the feet and tops of the rafters which hold the glass together, *they are, in all cases, constructive,* and so necessary to the maintenance of the whole fabric that they cannot possibly be dispensed with, and hence it follows, as a fixed rule, *that the more rafters and glass we have, the more ventilation openings must there be also.*

In illustration of this, we may take the next Drawings, which represent two houses of different shapes.











In the lower house, the centre part is higher and wider than the wings, and therefore has, on each side, one more ventilating plate or radial rib than the wings have; and in the upper house, which has a centre, with arms each way, the roof over the middle rises dome-shaped, with four radial pieces on each side of it: supposing the dome went higher, or the wings were wider, the radial pieces must take their proper places in the increased roof-surfaces; for the glass of which they are mainly formed is limited in length to three or four feet, and "laps" not being admitted, the roofs are like so many steps of about this width, with the pierced ventilators between them. It follows, then, that all buildings, if orchard houses, conservatories, green-houses, or hot-houses, and whether they are lean-to or span-roofed, when erected upon this plan, have, in the *structural* framing, all that is requisite to keep up a regular system of ventilation, each piece of glass, as it were, carrying with it the means by which this is effected; for the glazing cannot be done without rafters, and the rafters take their bearings upon, and are held together by, the pierced radial ventilating ribs, which run the whole lengths of the houses, admitting fresh, or drawing out heated, air, at every inch of their length.

From the great simplicity of this principle, and the readiness with which it can be applied, it scarcely matters what the shapes and sizes of the houses are, as the accompanying sheet will show, upon which two designs, of very different outline, are given.

The building at the head of the page is drawn to a much larger scale than the one below it. In plan it is a square, supported upon four angle-posts, with a lean-to house on each side of it, projecting from the face of the square about twelve feet. Here the ventilation ribs are in four rows to each front of the lean-to parts, and in three rows to each side of the top of the square, which is terminated conically.

The other building is shaped, in plan, like a wide letter H, with square dome-topped towers rising out of the middle of each side-wing, and is constructed and ventilated by four ribs to each side of the wings and towers, as the other house is.

In the one case, the building is a square, with notches out of it at the angles, presenting no great length or breadth, and covering only a small area; and in the other instance, considerable length is obtained in three directions, and the space of ground covered is large; but, if long or short, wide or narrow, square or oblong, conical shaped or domed, the ventilation pieces follow on with unchanging and correct proportions through all. In the very timbers by which the house is held together, we have all we need to effect its perfect ventilation; and if we wish to lengthen our building, or shorten it by one or two bays, or alter it in size in any other manner, so *structural* are the ventilating plates, that, whichever of these changes takes place, when it is done, the ventilating system must be correct.

In quoting from the "Book of the Garden," it has been shown that what were defects in some of the old houses, proved more advantageous than otherwise, because, so imperfect was the ventilation, that the over-laps and cracks in the glass were necessary for the health of the plants,—these openings being small, and very equally distributed. That which accident and bad glazing gave to the old buildings, arrangement, with improved glass, supplies to the new; for the means of equal distribution of air are gained and secured by the radial ventilators, perforated, as they everywhere are, with small openings, through which the air may constantly move, diffusing itself equally in all parts.

So thoroughly spread is the system, that every piece of glass has its separate quota of air-openings immediately under it, and all the openings being completely under control, where the sun may shine hottest, if even upon a single pane, there, air may at once be admitted to percolate through the radial rib and curl up along the inner surface of the heated glass.

The efficiency of the perforated ribs, is, in a great measure, owing to the horizontal and projecting positions they occupy in the roofs, for the air, as it travels over the ground, meets the side of the house, and is at once turned from its straight course, along one or another of the glass surfaces, to be caught by the over-hanging pierced pieces, and conveyed through the many openings in them into the building.

If the openings were vertical, instead of horizontal, this action could not go on in so perfect a manner, for much air would roll over the house, between any vertical apertures, and escape; and that which did pass in, would do so in upright thin-edged bodies, instead of in laminations, to rise or fall, the one body of air to the other, in endless but gentle motion.

Vertical openings in roofs have the great disadvantage of admitting rain as well as air, and, in wet times, houses so ventilated are subject to one of two evils—either a close and poisonous atmosphere, or water everywhere, upon the borders, in the pots, and flooding the walks; but these horizontal ventilators are so fixed and screened by the glass which covers them, that they can all be in full action during the wettest season, without fear of rain being driven in during the most pelting storm.

Many of our wet days are warmer and more oppressive than finer ones, and the bad effects of insufficient ventilation at such times, must have been very apparent to any one who has entered a closed or a partly-closed glass house in such weather.

To obtain any near approach to perfection in ventilation, the plan selected must not only be cheap and simple, but it must be such that can be made use of at one time as easily and as advantageously as another, and not admit of the necessity of being set aside because a storm of rain comes on, or the wind blows heavily.

It must provide, and regularly maintain—as it is known this Patented system does—a moderately brisk and continuous action of the fresh air entering the building in hundreds of softened currents, to gradually and yet thoroughly displace and draw off the stale and vitiated atmosphere, and keep up a regular change without producing any injurious drafts.

Again referring to Walker, we find:—"Vertical openings in
"upright walls, if they communicate immediately with the
"external atmosphere, are objectionable, because they are liable
"to be acted on by the prevailing wind, which, blowing some-
"times in one direction, sometimes in another, and sometimes
"not at all, renders their action uncertain, and not to be
"depended on. Generally speaking, the exterior terminations of
"all ventilating openings, whether for ingress or egress, should
"be in a horizontal rather than a vertical plane."

Although this refers to buildings of stone and bricks, instead of wood and glass, it is equally applicable to our purpose, the vertical openings previously alluded to being defective fully to this extent; but, by this horizontal arrangement, in whatever direction the wind blows, the large ventilating surfaces of the projecting ribs all stand open and ready to receive it. In fact, the unevenness of the roofs, externally, tends to conduct the air towards the ventilators; and this is found to be so, even when the wind strikes the end of the house instead of the side.

It is erroneous to suppose houses can be well ventilated by large openings of any kind, be they in the roofs or sides, for the end to be attained is a percolation, rather than a rushing, of air, through all the interior. Large currents of cold wind assimilate the temperature of the house, where it enters, to the state of the thermometer outside, and anything approaching to evenness of temperature within cannot be expected, but some of the plants will be in one climate, and some in another.

Strong currents on the one hand, and stagnation on the other, must be fully provided against, by always keeping up a gradual circulation, sufficient in extent to displace the vitiated air and to maintain a uniform supply, all parts of the house being acted upon evenly; and, unless the means employed effect this at all times, in wet weather as well as dry, when the wind blows from every point of the compass as well as another, the term ventilation becomes a mis-nomer, and might be dispensed with.

To be obliged to close up the openings of a conservatory, because it rains, or that the wind blows hard, gives the most positive evidence of ill-considered arrangement, or bad construction, or both; but, in hundreds of cases, if this is not done, the house is wetted and chilled, the trees nearest the apertures are drenched and starved, or the glass in the projecting shutters, or the hinges by which they are hung up, cannot withstand the wind pressure, and breakage takes place.

Although the climate within a glass building is artificial, it should be as natural as possible; and, as plants require as much air on a wet as they do on a dry day, it is not in accordance with the laws of nature ever to close the house and make it stagnant, any more than it would be to shut our lips against food when we are hungry. The leaves act to the plants as mouths, which must be constantly fed by adequate supplies of air passing over them, in fresh and pure streams, every minute, and the more regularly this air-motion is produced, the greater will be the advantages of this atmospheric food.

It is evident that the atmosphere of all climates is always, more or less, in motion, playing among the leafage of vegetation, not to sport with the tender shoot, or crop off the hardened bough, but to carry food and life with every breath to all in the wide world that is green with health; and, if we would have the trees and plants in our houses loaded with blossoms and fruit, and full of buds and flowers, this rule of nature must not be checked; and much the same is it with us in our homes—our health and life depending upon copious and constant supplies of pure air, to be, as far as possible, free from draughts; and to have this, in the words of Miss Nightingale, “your house must be so constructed as that the outer atmosphere shall find its way with ease to every corner of it. Badly-constructed houses do for the healthy what badly-constructed hospitals do for the sick. Once ensure that the air in a house is stagnant, and sickness is certain to follow.”

Far easier is it, by the system of perforated ribs we have so imperfectly described, to carry out thorough ventilation in our conservatories or orchard houses, letting the outer atmosphere with ease find its way to every corner, than it is to do so in our living and sleeping rooms; but even here this principle of ventilation can be adopted with little cost and very good effect, by making the meeting rails of the window sashes answer all the purposes of the radial ribs, and to do this it is only necessary to perforate the heads of the bottom sashes in a slanting direction from the top downwards and outwards, and over the openings so formed to hang small flaps, and which, when opened, should stand up edgeways parallel with the glass, to direct the fresh air towards the ceiling that its temperature might be heightened before it is felt by the occupiers of the apartment. Ventilation through small openings placed in this way in horizontal rows just above one's head, will neither produce objectionable drafts nor cause the hot and vitiated air next the ceiling to descend and be re-inhaled, as must always be the case when the upper sash is pulled down and the external atmosphere is allowed to enter the room at this high level.

The simplicity of our system, and the ease with which it is understood, are explained by one word—nature; for here we have it all—here we see if plants, for protection from our north-east winds and early frosts, are placed in glass houses, they necessarily become changed by the new climate, and must be treated as partial foreigners in their new location; and nature says, they must have as much air as they formerly required, and this air, to do them good and keep them healthy.

must roll over them, first from one side and then from another, much in the way it did before they were made to emigrate from the open nursery to the glazed roof.

The hundreds of small openings in the ribs, through which the air passes in as many little streams, each one gently moving and nourishing the plants in its journey through the house, dispelling noxious vapours, and carrying freshness with it everywhere, only represent the breaking up of a strong wind into numberless sections, as it travels through the trees and underwood of the hanging coppice, to strengthen and vivify the pet plants in the screened borders.

The supply of air to all vegetation, where naturally planted, is unlimited, for the wind blows alike over the tiny blade of grass and the stubborn thistle; and surely, when plants are changed from the open ground to buildings coated with glass, and facing the sun, they cannot require less air, but, in truth, often demand more; and, in arranging for this supply, with the object of having it copious at all times, controllable ever, and boisterous never, the beautiful laws of nature should be followed as closely as feeble and imperfect handiwork can imitate them.

To subject plants that are growing under glass, to all the rough currents that blow outside, by placing them in a house with large apertures, through which the wind rushes upon them in cold masses, puts them in direct contrast with the flowers of nature's garden, the tenderest of which are ever found

on the south sides of hedge-rows, or in hollow places screened from the cutting wind; but, even when here nestled among brambles, with their modest blossoms turned up to the ever glorious sun, they have the whole air of heaven to invigorate them, denuded, as it often is, of its fierceness, before it reaches them, by its percolation through the surrounding boughs, stems, and leaves; but it is ever present, and does not cease its life-supplying influence because the gentle shower falls or the heavy rain descends.

The perforated radial ribs can be opened or closed, in a whole house, as quickly as you can stroll up and down it; a mere touch to small flaps, which are adjusted over the air openings, being, according to one arrangement, all that is required to be done, and, as these flaps are generally about as long as the width of space occupied by two rafters, the ventilation can be as limited in extent, or as general in application, as may be judged best. There are neither cords, racks, pullies, wheels, quadrants, rods, nor any such appliances; nothing, in fact, but flaps of the most inexpensive kind, so fitted and applied, that air is excluded or admitted, everywhere or anywhere, with the greatest ease. There is nothing whatever in connection with this ventilation system that is likely to get out of order—no cords to break, or cogs to snap off in the frost—no irons to rust and work stiff, or quadrants to get out of shape—but all is simple to a degree, and, as nearly as possible, self-acting, for the opening or closing a flap is, in the time occupied, or force employed, too small to be computed.

Another plan of regulating the admission of air into these buildings has been most successfully carried out by placing valvular slides, with friction rollers, in grooves over the perforated radial ribs, and connecting them in such a manner that one side, or one half side, of the house can be opened entirely or partially by moving a handle; and, as the slide valves are close fitting and air-tight, they are, perhaps, more suitable than the flaps for houses where much artificial heat is employed. Care has been taken in each case to keep everything connected with the working of the ventilation system so simple that the probability of its getting out of order is scarcely likely; but if any accident does happen the construction is such, that any workman can set it right without the least difficulty.

After several trials which have been made with the glazing to some of these buildings, when used as conservatories or orchard houses, the best plan appears to be to slide the panes into grooves on the sides of the rafters, and put them in without putty. The grooves should be a little wider than the glass is thick, the flatness of the glass allowing the panes to be pushed into their places from the lower ends of the rafters. A corresponding groove has to be made in the radial rib to receive the top end of each pane; and so far we have the two sides and the top ends of the glass panes resting in the grooves. As the glass does not fit tightly here it must be secured from taking a downward motion and sliding out; this is done by screwing a small turn-button on the end of each rafter, the button being just long enough to go across the whole width of the wood,

and catch the corners of the panes on each side of it and hold them in their places. By giving these buttons half a turn, and making them vertical on the rafter-end, instead of horizontal, the edges of the glass are free, and any pane can be drawn from its place as easily as it was placed there. And in the fine autumn weather, when it is important the wood of the plants should ripen and harden for the coming winter, the whole or part of a house might have its glass removed by an ordinary labourer without risk or difficulty; and the same hand is equally competent at all times to effect repairs, or take out the glass if the house is to be removed, superseding the glazier, whose more expensive labour becomes quite unnecessary.

Glazing of this kind has been watched and examined with the greatest attention, during rain-fall of various degrees, and has also been tested by comparison with that in other houses, where the glass is fixed with putty, and laps are used; and it has been found that roofs glazed with long sheets of glass, in the manner described, keep out the rain at all times, when the other glazing always fails to do so; this defect being mainly owing to the capillary action in the "laps."

The reasons which may render it important to build side walls of bricks, and to use the valvular slides to the perforated ventilation plates instead of the flaps, may also apply with equal force to this mode of glazing, which might not be sufficiently air-tight for heated houses, in which cases the glass can be bedded in with putty in rebates, or in the grooves as already described.

It has already been said that these buildings are portable, and are constructed—without brick-work or stone-work—entirely of wood and glass. As we bring the glass down to the ground, we do not want side walls above the surface, and to get rid of them under the ground, the buildings are placed upon butts of old trees, or blocks of any durable wood, let into the soil sufficiently deep to bear considerable weight without sinking. These blocks form the foundation upon which rests the wood-work, and should be about six or eight feet apart, and level all round. Solid planks come immediately upon the blocks, and are spiked down to them; and upon the planks the other parts of the house are secured.

The only connection between the site—which might be the landlord's—and the building upon it—which might be the tenant's—is by the foundation blocks, and as they are buried it does not matter how rough they are, and being of little value, when the house is removed they need not be taken out of the ground.

The parts of which these buildings are composed are the radial ribs, the rafters, the ground-planks, the ridges, and the ends, the whole being fitted and screwed together without morticing, tenoning, or framing of any sort, so that when it is necessary to pull down and re-erect the house, this can be done by any workman without waste of wood or glass, each rafter, as well as every radial rib or other part, being screwed together again as firmly as ever. Any gentleman, fond of labour, may, with the assistance of his servant, either pull down and

re-fix one of these houses, or put it up in the first instance, for the pieces of which it is formed will fall into their right positions, to be fixed there by screws, as readily as an iron bedstead is fitted together. In new houses all the timbers will be numbered and marked, the screw-holes bored, and everything done before they are packed up and sent off, to make the work of erection as easy as need be.

The next and last illustration is a view of a Pavilion in the beautiful Public Pleasure Grounds at Worcester, and which was chosen by the Directors of the Company from many other drawings that were submitted to them in answer to advertisements for plans; the very effective system of ventilation here employed, led, to a great extent, to the selection and adoption of this Patented principle, over the many beautiful designs that were laid before the Directors at the same time.

Although this is not a green-house, but a building of wood and glass, where flower shows and such entertainments take place, the constructive ventilation and the general features are the same as to the houses already described, and such a building, with certain modifications, would answer equally as well for a conservatory as it does for a pavilion. The large end arches are filled in with moveable glazed frame-work, and the side arches have similar frame-work made to slide one piece behind the other, allowing each alternate compartment to be open.

Although the houses illustrated in this little book are mostly of plain form and regular outline, there is not the least



reason why the greatest degree of picturesqueness that glass buildings are capable of receiving, should not be obtained by the judicious application of this principle; and, to some extent, this will be made apparent by comparing the Worcester Pavilion with the other drawings.

Economy and usefulness have been considered before effective design, that it might be shown how buildings, although quite plain in detail and of the cheapest construction, can yet be handsome in appearance; and this, entirely by the outlines or shapes their simple parts, when screwed together, are made to work out; and if this has not been done as efficiently as it might have been, it will, nevertheless, in the words of Sir Humphrey Davy, serve some purpose, as "a history of failures invariably shortens the road to success."

1, Temple Row West,
Birmingham,

February, 1862.



PATENT BUILDINGS

OR HORTICULTURE.

"GOD ALMIGHTY FIRST PLANTED
A GARDEN, AND, INDEED, IT IS THE
PUREST OF HUMAN PLEASURES.
IT IS THE GREATEST REFRESH-
MENT TO THE SPIRITS OF MAN,
WITHOUT WHICH BUILDINGS AND
PALACES ARE BUT GROSS HANDI-
WORKS, AND A MAN SHALL EVER
SEE, THAT WHEN AGES GROW TO
CIVILITY AND ELEGANCY MEN
COME TO BUILD STATELY,
SOONER THAN TO GARDEN
FINELY, AS IF GARDENING
WERE THE GREATER
PERFECTION."

Bacon.

1. TEMPLE ROW WEST, BIRMINGHAM.

JAMES CRANSTON, ARCHITECT.